and maize (known locally as mealie), and vast areas have been extensively modified by grazing and burning. In the modified veld *Aristida junciformis* largely replaces *Anthistiria*. The bush, vlei, and other types of associations are much less extensive about Pietermaritzburg than are those of the veld. The paper is accompanied by a map, indicating the areas occupied by the different associations.—H. C. COWLES.

**The origin of coal.**—A recent bulletin[23] from the Bureau of Mines presents the results of extensive researches as to the origin of coal, long a vexed question. WHITE discusses the geologic relations of coals, analyses of coal samples studied under the microscope, physiographic conditions attending the formation of coal, rate of deposition of coal, and regional metamorphism of coal. DAVIS contributes an account of the origin and formation of peat; while THIESSEN describes in detail the results of a microscopic study of coal, prefacing his account with a full historical review of the subject. The bulletin is so full of important facts and interesting inferences that it is impossible to recount them here, but some of the general conclusions may be mentioned.

An important conclusion is that all coal was laid down in beds analogous to the peat beds of today; and that all kinds of plants, in whole or in part, went into the deposit. The various materials entering into the structure of plants differ widely in their resistance to the various agencies that were concerned in peat formation and in the subsequent coal formation. At the death of the plants, dependent upon the conditions in the bog, a partial decomposition, maceration, elimination, and chemical reduction begins, brought about chiefly by organic agencies, mainly fungi at first, and later bacteria. Such labile substances as proteins are removed first, and the more resistant next, leaving the most resistant in the residue called peat. The various processes referred to above, conducted chiefly by biochemical agencies, are taken up and continued by "dynamochemical" agencies, through various later stages, resulting in the different grades of coal, as lignite, subbituminous, bituminous, cannel coal, and anthracite. "Coal, therefore, is chiefly composed of residue consisting of the most resistant components, of which resins, resin waxes, waxes, and higher fats, or the derivatives of the compounds composing these, are the most important." These substances perform mainly protective functions in plants, as in cuticles, spore exines (including pollen), bark, cork, and waxy coverings. A very interesting result of these investigations is that any algal origin of coal was not demonstrated, although this has been a conspicuous and perhaps favorite theory.—J. M. C.

**Water requirement of plants.**—The ratio of the amount of water taken up by a plant during its growth to the dry matter produced has been found to vary very much, and it would seem that its careful investigation would

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[23] WHITE, DAVID, and THIESSEN, REINHARDT, The origin of coal. Bull. 38, Dept. Interior, Bureau of Mines. pp. x+390. *pls.* 54. 1913.

throw light upon the questions of what crop plants make most economical use of water and of what wild plants are best suited to their desert and semi-desert habitats. A former review[24] has called attention to the investigation of these problems by SHANTZ and BRIGGS during 1910 and 1911, while a more recent paper reports the results of the same investigators[25] obtained during the summers of 1912 and 1913. The investigations are remarkable for the extensive scale upon which they have been conducted, and for their duration throughout the growing season. More than 50 species have been the subjects of study, and for some the period of investigation extends over three years and includes many individual plants grown from seedling to maturity, the final result being the average of many determinations. As a rule, the same variety gave consistent results, although considerable differences were found between different varieties of the same plant; for example, the variety of alfalfa having the highest water requirement was nearly 50 per cent above the lowest.

Millet has proved throughout an excellent dry land crop, producing a unit of dry weight for every 310 units of water absorbed. It is closely followed by sorghum with a water requirement of 322, corn with 368, and sugar beet with 397; then come wheat with 513, barley with 534, oats with 597, alfalfa with 831, and others that it is impossible to enumerate here. Weeds show the greatest known range from such economic forms, as *Amaranthus* with 292, *Salsola pestifer* with 336, *Bouteloua gracilis* with 389, through such intermediate forms as *Xanthium commune* with 432, *Grindelia squarrosa* with 608, and *Helianthus petiolaris* with 683, up to *Ambrosia artemisiaefolia* with 948 and *Agropyron Smithii* with 1076. Like previous investigations by the same workers, this report contains a vast amount of exact quantitative data of value in studying the agricultural possibilities and the ecology of the great plains.—GEO. D. FULLER.

**The origin and relationships of the Indonesian flora.**—It is well known that WALLACE, basing his conclusions chiefly on animals, held to the idea of a sharp boundary line in the Straits of Macassar, separating the Indo-Malay and Australasian biogeographic regions. Not only were Borneo and Celebes thus separated biogeographically, but the line was supposed to separate such closely adjoining islands as Bali and Lombok, east of Java. Botanists generally have not found sharp lines between the Malay and Australian floras. HALLIER,[26] working under excellent auspices, finds that Asiatic types extend

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[24] BOT. GAZ. **56**:514–515. 1913.

[25] BRIGGS, L. J., and SHANTZ, H. L., Relative water requirement of plants. Jour. Agric. Research **3**:1–63. *pls.* 7. 1914.

[26] HALLIER, HANS, Die Zusammensetzung und Herkunft der Pflanzendecke Indonesiens. Separate reprint from J. ELBERT'S Die Sunda-Expedition des Vereins für Geographie und Statistik zu Frankfurt am Main **2**:275–302. *figs.* 2. 1912.